Forest Disequilibrium Distribution Appraisement Model and Rational Allocation of China

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***Abstract*-This paper is to study Forest Disequilibrium Distribution Appraisement Model and Rational Allocation of China, based on Gini coefficient theory of economics, and combining Chinese national status and forest condition. It is a risky and flawed when the forest cover ratio is only used to analysis on the disequilibrium of Macro-allocation of forest resources configuration. Forest macro-allocation is related to the improvement of inland environment, the ecological security and sustained development in economic society. The purpose of this paper is how to analyze macro-level allocation of forest resources scientifically. The model has been built in this paper, which is used to assess the unbalanced distribution of forest resource. This model can give a precise description about the level of the uneven distribution of forest as well as give an assessment when referring to evaluation parameters. The model is representative and the assessment of model is operability when guiding Macro-allocation of forest resources. The suggestion is to bring improvement forest resource equilibrium into planning of the forest strategy in China.**

Keywords-forest Lorenz curve; forest cover ratio; forest Gini coefficient

I. INTRODUCTION

The maintenance of ecological safety and the construction of eco-civilized society is the twenty-first century humanity's common theme, but also the important foundation of China's economic and social sustainable development. Forest, known as the "lung" of the earth, constitutes the major component of the terrestrial ecological system. With their most complex structure, abundant varieties of species and stable function, forest plays a decisive role in maintaining and improving the ecological environment as a whole in China. Entering the new century, China, whose aim is to build itself into a well-off society, is confronted with the increasingly sharp contradiction between the growing diversified demands and the backward forestry production. Forestry will be not only to meet the demands of the society for timber and timber products, but also to shoulder the heavy tasks of improving the ecological environment and maintaining the national ecological security. The Decision of the State Council on speeding up the Development of Forestry points out that forestry construction must be given a higher priority. In the course of building a well-off society and stepping up the socialist modernization drive, great importance must be attached to forestry work and tremendous efforts must be made to push forward China's forestry at a big pace. Forestry shall be given an important standing in implementing the sustainable development strategy, the first standing in ecological environment construction and the fundamental standing in great western development. Obviously, China has a long way to go in protection and development of its forest resources. Macro-allocation of forest resource is related to the ecological security, the improvement of inland environment and sustained development in economic society.

In a sense, forestry development is indeed a forest resources rational allocation as the main issue. Forest resources distribution is an important aspect of forest resources configuration. World Forestry Conference holds that a country or region for more than 30% forest cover, and roughly balanced distribution can basically meet the requirements to improve the environment. Currently an important issue facing our country is that distribution of forest resources and improve the ecological environment protection are still far from meeting, will be more striking. Even after sixty years of long-term unremitting efforts, forest resource protection and development has made great achievements, China is still a forest-poor country, the total lack of quality, and uneven distribution of forest ecosystems as a whole is very fragile.

Relatively balanced distribution of forest resources is to achieve rational allocation of forest resources and macroeconomic conditions, a basic law and principles, but current lack of a systematic theory and empirical research on how to measure and evaluate them quantitatively. On the other hand, forest cover has been incorporated into the measure of China's eco-regional sustainable development, environmental quality indicators, as well as strategic planning for forestry development in China, but people tend to rely on a single forest cover as indicators of the distribution of forest resources, and indicators of forest cover defects inherent lack of awareness, the lack of forest resources reflects the overall non-equilibrium distribution of the quantitative analysis tool. This is very easy to bring decision-making risk, can not meet the land ecological security and sustainable economic and social development of forest resources, macro-configuration requirements. Therefore, the study on disequilibrium distribution and changes of China's forest resources is not only rich in forestry economic theory needs, but also to protect and develop forest resources in China, improve the environment.

From the point of forestry economic theory, the key feature of forest resources is to ensure a relatively uniform distribution across the country during a long term [1]. In order to answer the questions about the current distribution of forest resources and the rate of forest cover, we should firstly find a description of non-equilibrium methodology and establish a model of non-

equilibrium evaluation. However, there is still a lack of a representative non-equilibrium evaluation model of forest resources which based on the theory of economics. In view of these problems, this paper attempt to establish a model of non-equilibrium evaluation based on the Principles of the Gini coefficient, and to solve the problem of accurate calculation of the Gini coefficient. On this basis, we could analysis the change of forest conditions scientifically and find a law between the distribution of forest resources and economic development. From the forestry development objectives, China's forest coverage has become a core strategy for forestry construction goals [2]. But whether the increasing of forest cover could bring the ecological conditions into the virtuous circle should still rely on analysis and summary of the past practice. Therefore, the empirical characteristic of forest resource is important in complementing and improving the forestry planning realistically and reducing the risk of planning.

II. THE DISEQUILIBRIUM MEASUREMENT METHOD OF FOREST RESOURCES DISTRIBUTION

A. The Principles in Measurement Method Choice of Forest Resources Distribution

The measurement and evaluation of forest resources distribution model is a detailed and complex modeling work. This paper argues that the specific method choice for measurement and evaluation model of forest disequilibrium distribution must follow the following important principles: 1) quantitative principle. Disequilibrium distribution of the forest to evaluate the degree of difficulties encountered, which requires the evaluation must be quantified. 2) Scientific principle. That should be based on scientific theory, based on scientific analysis and evaluation should be able to regional forest resources, the nature of the distribution of characteristics. Choose not only reflect the actual situation comparable indicators, to ensure the scientific results of the analysis. 3) Feasibility principle. Feasibility calculation is easy to grasp, easy to statistical data required. The data required under the existing conditions can be directly or indirectly. 4) Systematic principle. As a whole, that should reflect and measure the main features of the system being evaluated and the situation. 5) Dynamic principle. As far as possible that should be comparable with the dynamics of different periods. 6) The principle of objectivity. That the objectivity of evaluation parameters. Evaluation parameters should have the measure of the system change and quality of the merits of "comparative scale standards." Index value and the evaluation results should ensure objectivity and testability. Without the appropriate parameters, you can not make an objective scientific evaluation.

B. Drawing on the Principle of the Gini Coefficient Distribution of Forest Resources to Solve the Problem of Non-equilibrium

This paper argues that the introduction of Western methods of economic analysis, the use of the Gini coefficient analysis of forest resource allocation principle of non-equilibrium problems, scientific and feasibility. Five reasons: 1) studying the problem from the point of view, the Western Economics of Forest Economics study guide. Investment in forestry, forest resources are limited. Maintenance of ecological security is difficult. How to use the limited forest resources to meet people's needs is to study and solve the basic problem, in fact, resource allocation study. The allocation of scarce resources is the study of economics. 2) From the research point of view, Western economics of forestry economics study guide. Currently, the Western Economics is the most mature social science disciplines, but also the most successful imitation of natural science disciplines, so that some economists say it is "the first social science." Western economic system from the beginning to the present has more than 300 years of history. In recent years, economics, social research methods are widely used in other areas of the economy, the emergence of financial economics, industrial economics, resource economics, crime, economics, technology, economics, and energy economics. Economics in expanding the boundaries of this trend is vividly called "economics imperialism trend." Among them, the Gini coefficient principle is an important basic Western economic theory. Although the theory is to study the issue of income distribution, but the essence is to study the resources of non-equilibrium configuration problem. The non-equilibrium analysis is instructive. 3) From the disciplinary system, the Western Economics of Forest Economics study guide. The forestry economics is applied economics, economics and cross-product of forestry science. In principle, the modern Western economics, the general method of allocation of resources for forestry. In this paper, China's national conditions, forest conditions, the application of contemporary principles of economics, to learn the useful elements of Western economics, try to study the forest resources in China's macro-configuration problems. 4) Another advantage of the Gini coefficient theory is that not only measure shows the distribution of income of disequilibrium level, and can use its standard parameters to make an objective evaluation. 5) From the forest resources, the Western economic theory of resource allocation guidance to forestry economics. A reasonable guide and regulate the flow of resources to achieve the optimal allocation of resources and make full use of economics to study the basic problems. Because China's forestry production and management level is relatively low, Forestry and Economic Research has yet to international research standards, also failed to provide China with forestry, forest management characteristics and the actual configuration of forest resources and examples of reasonable. In this paper, principles of economics on the basis of analysis, combined with the actual situation of China's forestry and put forward the direction of our future allocation of forest resources designed to make China's forestry economy and the economic theory of the specific issues more closely, enrich and improve the China's forestry economic theory, but also for the sustainable development of forestry in China to provide more theoretical basis. View of this, that can learn the basic principles can be used to study and solve the disequilibrium distribution of forest resources evaluation, and distribution of forest resources to meet the modeling methods should follow the principle requires.

This paper also argues that the use of the Gini coefficient analysis of forest resources, the principle of non-equilibrium configuration issues, but also with considerable difficulty. I found that the Gini coefficient is a difficult theory to analyze the general problem of resource allocation, rather than for forest resources, and evaluation of forest non-equilibrium framework of economic analysis and representation of the literature is scarce. The second difficulty is the Gini coefficient from the theoretical principles of conversion to the project specific analysis method there is a big difficulty, it is the principle layer theory of knowledge, not a tool layer theory of knowledge, can not directly use. Therefore, this article assimilates their way of thinking the establishment of forest resources in economic models, the conversion of its analysis of variables. The third difficulty is Lorance curve equation and accurate calculation of the Gini coefficient more difficult. Because Lorance curve is bent, and the Gini coefficient is entirely unequal size and unequal area ratio, and their area is curved shape. This is prone to large errors if the straight trapezoid area formula. In addition, the calculation is not small. The fourth difficulty is that forest resources belong to the specific resource allocation, how to combine the analysis of the characteristics of forestry is also a difficulty.

III. THE DISEQUILIBRIUM EVALUATION MODEL OF THE FOREST RESOURCES DISTRIBUTION

A. The Exact Formula of Gini Coefficient of Forest Resources

The principle of Gini coefficient is an important fundamental theory in Western Economics. Judging from the research problems, although the theory is used to research income distribution, its essence is the study of non-equilibrium of the distribution of resources. Considering this, the basic principle can be used for reference to study and solve the problem of the evaluation of non-equilibrium distribution of forest resources. The difficulty of applying the Gini coefficient principles to build the evaluation model of the non-equilibrium distribution of forest resources is the accurate calculation of the Lorenz curve equations and the Gini coefficient. Because Lorenz curve is curved, and the Gini coefficient is the ratio of unequal area and entirely unequal area, their area is shaped with curved edge. If you use the straight edge trapezoid area formula, it will result in considerable error. Suppose y (x) for the Lorenz curve equation of the forest resources. According to the definition of the Gini coefficient, the Gini coefficient of forest resources accurately calculated as (1):

$$G = 1 - 2\int_0^1 y dx \tag{1}$$

B. Non-equilibrium Evaluation Model of Forest Resources

Change the vertical axis of the Lorenz curve [3] in economics into y, which stands for a percentage of total forest area, and change the horizontal axis into x, which stands for a percentage of total land area. Then n-sample forest inventory adds to origin. The specific value of Yj is Ij. We can use the "n+1" points in [0, 1] with n equal portions to represent:

$$(x_0, y_0)=(0,0),\ (x_1, y_1)=\left(\frac{1}{n}, \frac{I_1}{\sum_{j=1}^{n} I_j}\right)\ (x_{n-1}, y_{n-1})=\left(\frac{(n-1)}{n}, \frac{\sum_{j=1}^{n+1} I_j}{\sum_{j=1}^{n} I_j}\right)\ (x_n, y_n)=(1,1) \tag{2}$$

Thus, we can consider using the Quadratic or Cubic function to fit the Lorenz curve of forest resources, and to accurately determine the Gini coefficient of forest resources. If the Lorenz curve of forest resources is supposed to be a quadratic function, the specific practice is to set:

$$y = a + bx + cx^2 + \varepsilon \tag{3}$$

Use the OLS method [4] in econometrics to determine the parameter estimation of the upper equation. Then according to the relationship of the Gini coefficient and the Lorenz curve, we can get the Gini coefficient of forest resources. Substitute Equation (3) into Equation (1), obtaining:

$$G = 1 - 2\int_0^1 y dx = 1 - 2\int_0^1 (a + bx + cx^2) dx \tag{4}$$

Assuming that the Lorenz curve of forest resources is a Cubic function, we can set:

$$y = a + bx + cx^2 + dx^3 + \varepsilon \tag{5}$$

Then we can use the OLS method in econometrics to determine the parameter estimation of the upper equation. According to the relationship of the Gini coefficient and the Lorenz curve, we can get the Gini coefficient of forest resources. Substitute Equation (5) into Equation (1), obtaining:

$$G = 1 - 2\int_0^1 y dx = 1 - 2\int_0^1 (a + bx + cx^2 + dx^3) dx \tag{6}$$

Equation (4) or Equation (6) is the non-equilibrium evaluation model of forest resources situation that we want to get in this paper, which is denoted as FEM model. With it we can quantitatively and accurately measure the level of the uneven distribution of forest resources, determine the overall ecological status of forest, analyze and measure the "gap" of forest resources in regions with the international standards, and interpret the capacity of forest resources to bear the weight of socio-economic.

IV. THE EMPIRICAL ANALYSIS ON THE UNBALANCED DISTRIBUTION OF OUR COUNTRY'S FOREST RESOURCES

This paper will make an empirical analysis on the forest's condition and its change with the following model of FEM, which full name is Evaluation Model on the Unbalanced Distribution of forest resources.

A. Determination of the Forest's Lorenz Curve and its Trend

According to the fifth national forest inventory data announced in 2002, calculating the Land area accumulative ratio and the Forest area accumulative ratio, getting the forest's Lorenz curve (see "Fig. 1"). According to "Fig. 1" (the fifth national forest inventory) and some kings of trend line adding on it, we can see that conic curve and cubic curve have good degree of

fitting, which also prove the validity of equation (3) and (5). Similarly, we can get the same conclusion using the forth national forest inventory data.

B. Determination of the Evaluation Model of Unbalanced Distribution of our Country's Forest Resource

The deviation of the Land area accumulative ratio u=x-the average of the Land area accumulative ratio, calculating u^2, u^3. Defining $u=X_1$, $u^2=X_2$, Then:

$$Y=a+bX_1+cX_2 \quad (7)$$

Estimating the parameter in (7) using the OLS method, we can get the result (8) and (9):

$$Y=0.2646+1.3647X_1+1.774X_2 \quad (8)$$

$$Y=0.2646+1.3647(x-0.649)+1.774\,(x-0.649)^2=0.1259-0.9373\,X+1.774X^2 \quad (9)$$

Various Statistical Tests on the Evaluation Model

Firstly, the goodness of fit test, equation test of significance and the regression coefficient significance test (see table Ⅰ, Ⅱ, Ⅲ). The statistic test results of (8) show that goodness-of-fit is high, and that significant test prominent. Each regression coefficient is significant different from zero. Each independent and dependent variable has significant linear relationship.

TABLE I. MULTIPLE R OF REGRESSION

Multiple R	*R Square*	*Adjusted R Square*	*Standard error*	*Observations*
0.9980915	0.9961866	0.9959142	0.0216244	31

TABLE II. VARIANCE OF REGRESSION

df	F	Significance F
2	3657.3279	1.37489E-34

TABLE III. TEST OF REGRESSION

Item	Coefficients	Standard error	t Stat	P-value
Intercept	0.264589	0.005748	46.030601	6.20E28
u	1.364682	0.015987	85.360917	2.17E-35
u^2	1.773979	0.060183	29.476189	1.26E-22

TABLE IV. EMPIRICAL RESULTS

Item	The fourth inventory	The fifth inventory	The value of change	The rate of change (%)
Gini coefficient of forest resources	0.497	0.503	+0.006	1.2
Coverage of forest resources	13.92	16.55	+2.63	18.9
Forest area	1337035	1589409	+252374	18.9

Secondly, the residual analysis is carried out. Residuals from the scatter plots drawn (see Figure 2, 3) can be seen that the residual sequence is essentially random, then the residual series has nothing to do with the u value, the residual sequence has nothing to do with the square of u values. Residual sequence is essentially random. And through observation, there was no heteroskedasticity. Standardized residual series from drawing the cumulative probability plots (see Figure 4) can be seen by visual observation of the graphic, you can determine the residual series was close to normal distribution.

Thirdly, the multicollinearity analysis is carried out. The correlation coefficient between the explanatory variables is the square -0.402238. The Tol is 0.838 and close to 1, (9) multicollinearity is weak. Adopt a similar process can be cubic polynomial regression equation:

$$Y=-0.0068+0.0991X-0.3355X^2+1.238\,X^3 \quad (10)$$

But the Tol is 0.264, indicating that (10) has strong multicollinearity. Therefore (8) is the best. Similarly, the fourth forest inventory of available forest Lawrence curve corresponding to the trend line, see (11). Statistical test showed that (11) goodness of fit is high. Significant F statistics, a significant regression coefficient test. Residual sequence is essentially random, and close to normal. There was no heteroskedasticity. Multicollinearity is weak. Therefore (11) is the best.

$$Y=0.1161-0.8806X+1.7264X^2 \quad (11)$$

C. Using Lorenz Curve of the Trend Line on the Gini coefficient Calculation

Here, Find out the fourth and fifth inventory of forest resources in the Gini coefficient by using Lorenz curve (9) type and Gini coefficient calculation formula (4) type respectively. The calculation results see table Ⅳ.

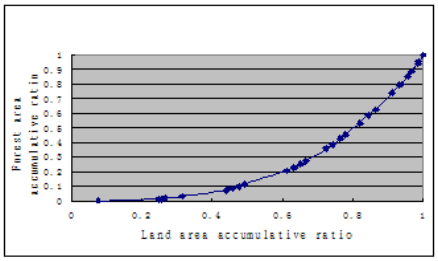

Figure 1. Forest's Lorenz curve of the national forest inventory

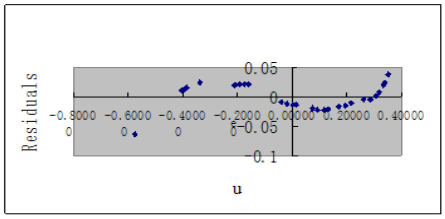

Figure 2. Residuals Plot for U

V. DISCUSSION OF THE EMPIRICAL RESULT

Chinese country forest resources has the following characteristics in terms of the forth and fifth forest check [5].

Firstly, Chinese country is not only in great lack of forest resources, but also its distribution is so unbalanced that the polarization is quite serious and regional ecological environment is still weak. It can be seen that the Gini coefficient is 0.503 during the fifth check, which is added 1.2% from 0.497 during the forth check. The result is well over the alert level of 0.40 and more worse, reaches the polarized line of 0.50 when referring to international standard. Chinese forest cover rate increases 18.9% which means the area of forest adds 252374 (see table Ⅳ). However, the distribution is so unbalanced that there is a serious polarization and a weak regional ecological environment.

Secondly, Chinese country forest distribution fit the Lawrence curve and there is a visible bend which is going worse (see "Fig. 5"). That means China has failed to make the distribution uniform with the forest cover rate increasing. There is no sign that the distribution is on the way being balanced, which is confirmed to cost a long time, on the contrary, it is going worse. It is clear that Chinese country forest resource allocation doesn't allow the regulation that Chin must try best to make the forest resources distribution uniform all over the country in terms of forestry economic practice.

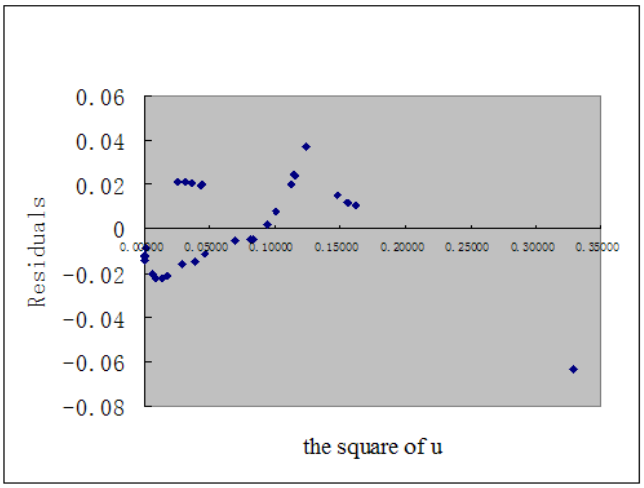

Figure 3. Residuals Plot for the square of u

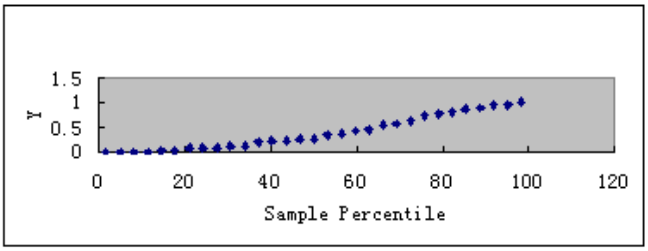

Figure 4. Normal Probability Plot

VI. SUGGESTIONS

In order to improve the distribution of non-equilibrium of forest resources and maintain ecological security of China, the suggestions are as follows:

A. Bring the Requirements of Improving the Relative Balance of Forest Resources Distribution into the Forestry Strategic Planning

Indicators of forest cover have deficiency. Firstly, one-sided pursuit of high indicators of forest cover leads to statistics defects. Forest coverage rate is an average, if we list forest resources in all areas of the Fifth forest resources inventory, we'll find out that Forest cover data will change from the minimum 0.43% to about 16.55%, even some great value such as 60.52%. Under this circumstance, it can be concluded that it is not at efficiency of comparing this year's average forest cover with last year's. "The average forest cover" not only hides the forest resource situation of 0.43, and concealed the condition of forest resources of up to 60.52. Secondly, one-sided pursuit of high indicators of forest doesn't mean good environment and virtuous circle of ecological condition. If the forest resources are polarized, the ecological conditions are likely to be "the poor poorer, the rich richer", and as a results, threatening the national ecological security.

Forestry strategic planning is of overall importance. Once the forest resources fails, it will lead to far-reaching and long-term adverse effects to ecological security, or even wreck the healthy development of social economy and shake the hard-won forestry constructive position. Therefore, China should make Chinese forestry strategic plan carefully and scientifically, in order to reducing the planning risks. Insisting on Scientific Development, bring the requirements of improving the relative balance of forest resources distribution into the forestry strategic planning. Considering comprehensively with forestry cover rate and forestry distribution balance on the issue of allocating forest resources, we should correct the deviated awareness in order to achieve regional ecological security and regional economic coordinated and healthy development.

B. Paying Attention to Interdiscipline Study of Forest Resources Science with Economy and Law, Seeking Actively the Effective and Feasible Strategy of Evolution of Water Resources in Arid Areas for Improving Forest Resources Allocation.

Northwest area is arid and semi-arid region, with vast land, but has relatively poor water resources. Water resources are main limiting factor of local forestry development and ecological protection. In the context of global climate changing, the future change in water resources in Northwest China is not only an important scientific problem, but also has important practical significance to planning of local development strategies. In August 2005 in "Annual Meeting of Chinese Association", Honglie Sun, chief expert of Chinese Academy of Sciences and China Council for International Cooperation on Environment and Development, pointed out that in the future, research should focus on strengthening the warm and wet climate change caused by the two inland river basin a water source - the ice zone and

forest zone change on mountain runoff combined effect of the total runoff. That include: Northwest territories and the warm dry climate warming on the scale of transition changes in time and space; the context of climate change, changes in evaporation of the Northwest Region; climate change on mountain snow runoff zone and forest zone of the overall effect.

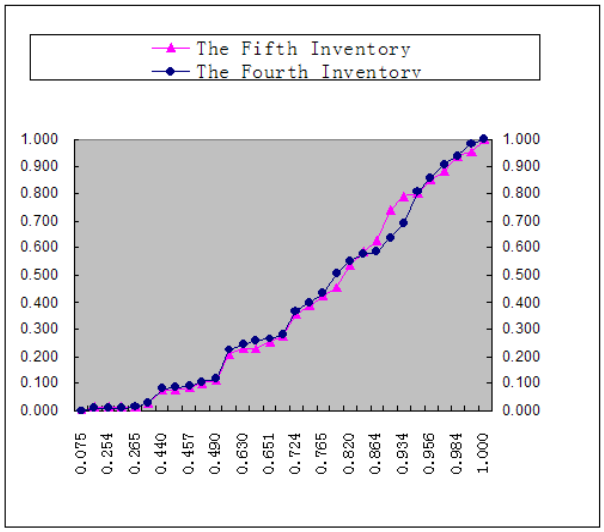

Figure 5. Comparison of Lorenz Curves of Forest Resources

Yafeng Shi, Chinese geographer, Chinese Academy of Science, has been studied on climate and water resources changes in Northwest China for a long time. He believes that in 20th century, the northwest arid area is in a process of acidifications and water resources shrinking, and the climate of west in Wuxiao Ridge and Riyues Mountain in later period in 80's in the 20th century was changing wetter [6]. In June 2005 in Lanzhou, "Science & China" meeting he reported the following points: "The future trend of achieving increases in precipitation, combined with increasing glacial melt water, the Northwest and Qinghai-Tibet Plateau runoff or surface water resources also increasing trend, northwest and east of the Yellow River source region the phenomenon of drought has been going on for many years will be transferred rainy wet season."

Chaozhou Chen, expert of Chinese Academy of Sciences and Institute of Geographic Sciences, made a further laboratory study of precipitation in the Northwest region west of the late 80s from the 20th century. He pointed out that an increasing trend of rain falling in Western area has been confirmed by meteorological and hydrological data [7].

In view of the above situation, we should strengthen the science of forest resources environmental and economics and law of discipline overlapping comprehensive research. Workers of social science should actively explore the source of conflict and key links at economic and social level, while natural science researchers should be aimed at the key natural science problems, provide accurate assessment of information. Only natural science and social science can we find out the effective feasible strategy of collaboration forest resource allocation and forestry ecological construction.

VII. CONCLUSION

Firstly, a model has been built in this paper, which is used to assess the unbalanced distribution of forest resource in base of economic theory. This model can give a precise description about the level of the uneven distribution of forest as well as give an assessment when referring to evaluation parameters. The theory of model is representative and the assessment of model is operability when guiding Macro-allocation of forest resources.

Secondly, the Polarization of forest distribution and the miss of Indicators of forest cover rate bring a drawback which determines that it will make great sense when improving the unbalanced distribution of forest resource and completing Forestry Planning in China. What's more, it is meaningful for diminishing the planning risk as well as steadying the forest resource strategic position which is hard –won.

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